REMARKS

Applicant thanks the Examiner for the thorough consideration given the present application.

To expedite prosecution, the specification is amended to insert the section headings requested by the Examiner, and the British spelling of "sychronise" is changed to the American spelling.

Applicant notes with appreciation the indication in the Office Action that claim 3 contains allowable subject matter.

By this Amendment, claims 1, 7, 11, 13, and 14 are amended to use the slightly broader term --shutter arrangement-- rather than "shutter".

Claims 1, 6, 7, 10, 11, and 13-15 are also amended to address the informalities noted in the Office Action. However, Applicant disagrees that the word "is" should be deleted after "pulsed" in claims 5 and 6. Such a change would render the claims incomprehensible. Claim 5 would read in part "the rate at which the strobe is pulsed at least 50 Hz", and claim 6 would read in part "the rate at which the strobe flash is pulsed at least 10 times higher than the image capture rate".

Claim 14 is further amended to indicate that the actuator is operable to scan the field of view of the objective lens as the

control circuitry captures images of different segments of the document.

To provide Applicant with the protection to which he is deemed entitled, claims 16-18 have been added. Claims 16-18 are independent claims that are substantially the same as claims 1, 11, and 13, except that the limitation for "pulsing the strobe flash at a rate which is sufficiently quick that the illumination appears to a user of the camera to be substantially steady owing to persistence of vision" reads --to pulse the strobe flash at a rate of at least 16 times/second--. Since persistence of vision is at a rate of at least 16 times/second, the modified feature of claims 16-18 is inherent in the apparatus disclosed in the application as filed. In this regard, see the persistence of vision article accompanying this Amendment and discussed below.

Applicant traverses the rejection of claims 1, 2, 4, and 7-10 as being anticipated by Ishii (U.S. Patent No. 5,539,456). The Office Action mischaracterizes the Ishii patent by saying it discloses pulsing strobe flash 9 at a rate which is sufficiently quick that the illumination appears to a user of the camera to be substantially steady owing to the persistence of the vision.

The Office Action also mischaracterizes Ishii by saying that the Ishii shutter is synchronized to capture one or more images by the detector for image capture such that each image being captured

with at least one pulse from the strobe flash is at a rate substantially below the rate at which the strobe flash is pulsed.

Ishii fails to mention anything about persistence of vision or the relative rates at which the strobe is pulsed compared to the shutter speed. An inspection of the Ishii reference, coupled with some knowledge of persistence of vision, enables one of ordinary skill in the art to realize that the Ishii reference does not include the two above-noted features.

As indicated by the accompanying article concerning persistence of vision found in the Internet at http://www.fact-index.com/p/pe/persistence of vision 1.html (downloaded from the Internet on May 26, 2004), a movie frame rate of less than 16 frames/second causes the mind to perceive flashing images. Theatrical film runs at 24 frames/second to assure that persistence of vision is maintained. Hence, to assure persistence of vision, there must be light incident on the eye of a human observer at least 16 times/second, i.e., there must be one frame every 1/16 second or at a higher frequency.

An inspection of the Ishii waveforms indicates strobe light emission occurs in Ishii at a frequency of less than 1/16 second. For example, in FIG. 10, waveform I includes two waveforms indicating strobe light emission. The strobe light emission pulse on the left side of FIG. 10 has a smaller amplitude for a shutter speed of 1/125 second than the pulse on the right side, associated

with a shutter speed of 1/250 second. The time τa associated with the pulse on the left side is greater than the time τa associated with the pulse on the right side. Time durations of τa are delay times initiated at the completion of a charge accumulation cycle, indicated by waveform E of FIG. 10. The two strobe light emission waveforms I of FIG. 10 represent two different shutter speeds, as indicated by the broken lines in each of FIGS. 10A-K. The left portion of FIG. 10I represents approximately four vertical scan fields, each having a duration of 1/60th-second, as indicated by FIG. 10A. In other words, the strobe light emission indicated on the left side of FIG. 10I is shown as a single pulse that occurs over an interval of four and probably many more, i.e., 4/60 second or more, i.e., 1/15 second. Similarly, the strobe light emission on the right side of FIG. 10I is associated with four or more vertical scan fields, each having a duration of 1/60 second, i.e., 1/15 second. The strobe light emission pulses of FIG. 10I only occur once in response to shutter switch 34 being closed, as indicated by the pulses labeled "ON" in FIG. 10G. Hence, the foregoing shows that Ishii does not disclose the requirement of claim 1 for a strobe flash to be pulsed at a rate which is sufficiently quick that the illumination appears to a user of the camera to be substantially steady owing to persistence of vision.

The waveforms of FIG. 10 also shows that Ishii does not include the claim 1 requirement for a shutter arrangement that is adapted to capture images at a rate substantially below the rate at which the strobe flash is pulsed. The left portion of FIG. 10 indicates the shutter speed is such that during one frame having a duration of 1/60 second, the shutter speed is 1/125 second, i.e., there are two image captures by the shutter opening and closing during each frame having a duration of 1/60 second. FIG. 10I indicates a strobe light pulse occurs at a much slower rate than the 1/125 second shutter speed. Since the strobe light emission pulse occurs in response to the shutter switch 34 being activated to an ON condition, the strobe light emission is aperiodic and cannot be considered to have a rate. The right portion of FIG. 10 indicates the shutter speed is 1/250 second, that the shutter speed is approximately four times the 1/60 second frame rate and much greater than the stroke "rate." Consequently, the position in the Office Action that the Ishii shutter captures images at a rate substantially below the strobe flash pulse rate is incorrect.

Claims 2, 4, and 7-10 are allowable for at least the same reasons advanced for claim 1, upon which they depend. In addition, some of these claims include features not disclosed in the applied art, including Ishii. For example, claim 2 requires the perceived intensity of the strobe to be ramped up prior to image capture and/or ramped down after image capture. The Office

Action contends that column 9, line 45+, and FIGS. 9, 10, and 14 show this feature. In fact, at column 9, line 45+, Ishii discusses changing the delay times τa initiated at the completion of a charge accumulation cycle for the different possible shutter speeds of the Ishii camera. Hence, τa has nothing to do with ramping up/down the strobe light emission waveforms illustrated in FIG. 10I. FIG. 9 depicts a plot of an AGC amplifier output (in the horizontal direction, i.e., on the X-axis) versus illumination intensity on objects (in the vertical direction, i.e., on the Y-axis). FIG. 9 has nothing to do with ramping up/down the intensity of the strobe light.

Applicant traverses the rejection of claim 1 under 35 U.S.C. §102(e) as being anticipated by Shinoda et al. (U.S. Patent No. 4,567,506). Shinoda et al. fails to disclose the claim 1 requirements to pulse the strobe flash at a rate which is sufficiently quick that the illumination appears to a user of a camera to be substantially steady owing to persistence of vision. Further, Shinoda et al. fails to disclose a shutter adapted to capture images at a rate substantially below the rate at which the strobe flash is pulsed.

In the Shinoda et al. system, stroboscope 11 is pulsed at a rate determined by marginal gear 8 (*column 2, lines 58-60*). Sampling circuit 18 responds to marginal gear 8 to supply a pulse

once per second to television camera generating circuit 19 (*column 4, line 48*). Consequently, stroboscope 11 is pulsed at a rate of once per second, a rate much lower than that to achieve persistence of vision. In order to have persistence of vision, stroboscope 11 must be pulsed at a rate of at least 16 times/second. Thus, Shinoda et al. does not disclose pulsing a strobe flash at a rate which is sufficiently great that illumination from the strobe flash appears to a user of camera 12 to be substantially steady owing to persistence of vision.

FIG. 3 of Shinoda et al. also makes it evident that stroboscope 11 is pulsed at a rate that is less than the rate of persistence of vision. In this regard, more than three fields, each having a duration of 1/60 second, are illustrated in FIG. 3. The strobe pulse light is illustrated as occurring at most once in FIG. 3(a) during this interval of more than 1/20 second. There is nothing in Shinoda et al. to indicate that another strobe pulse light occurs sufficiently soon to enable persistence of vision to be attained. As discussed previously, there is only one strobe pulse light every second in the Shinoda et al. device.

The allegation in the Office Action that the strobe flash is pulsed at a rate of 30 microseconds is incorrect. The strobe pulse light has a *duration* of 30 microseconds.

There is no disclosure in Shinoda et al. of a shutter having a speed that is substantially below the rate of the strobe pulse. The Examiner cites column 1, lines 55+; column 2, lines 65+; and column 3, lines 15+, for this feature. Attorney for Applicant has considered these portions of Shinoda et al. and fails to find any relationship between the Shinoda et al. strobe light and any shutter speed. In fact, Attorney for Applicant cannot even find a mention in Shinoda et al. of a shutter. If the Examiner is considering a frame or field of Shinoda et al. to be the same as a shutter, Applicant notes that the frames have a duration of 1/30-second, and the fields have a duration of 1/60-second. However, the Shinoda et al. stroboscope is pulsed at a rate of once a second. Consequently, Shinoda et al. does not inherently include the feature of a camera shutter speed that is substantially below the strobe pulse rate.

Based on the foregoing, the anticipation rejection of claim 1 based on Shinoda et al. is wrong.

Applicant traverses the rejection of claims 5 and 6 under 35 U.S.C. §103(a) as being obvious over Ishii in view of Sakamoto (U.S. Patent No. 5,881,326).

The Office Action alleges that Sakamoto discloses the use of a strobe flash unit having a strobe flash pulse rate of at least 50 Hz and at least ten times higher than the image capture rate, which the Office Action correlates to the statement at column 12,

lines 45+. Column 12, lines 45+, states that the stroboscopic illumination has a period of 1 millisecond or less. The Office Action alleges column 14, lines 32+, discloses a shutter rate of 10 milliseconds. Attorney for Applicant cannot find such a statement and requests clarification.

The reliance in the Office Action on column 9, lines 55+, for the allegation that the strobe flash is pulsed at at least 50 Hz is incorrect. Column 9, lines 55+, discloses pulse width modulation circuit 50 alternately turns on two pairs of transistors 56, 57 and transistors 55, 58 at a constant frequency of, for example, 50 KHz to provide power pulses to coil 13c in alternate directions. Coil 13c drives shutter blades 11, 12 that are located between light-emitting diode 18D and photoresponsive element 15. The integrated value of the output of photoresponsive element 15 controls the strobe discharge 26 so the strobe is turned off when the integrated value of the light incident on photoresponsive element 15 reaches a predetermined value (*column 8, line 60, through column 9, line 53*). Apparently, the time for the integrated value of photoresponsive element 15 to reach the predetermined value is many cycles of pulse width modulation circuit 50.

As indicated in the paragraph bridging columns 8 and 9 of Sakamoto, the integrated amount of light received by

photoresponsive element 15 causes strobe circuit 25 to be automatically started if the exposure time is excessively long. Hence, because the amount of integrated light on photoresponsive element 15 controls activation of strobe circuit 25, it appears that activation of strobe circuit 25 is aperiodic and occurs only under low light conditions. At most, activation of strobe circuit 25 appears to be at the same rate as the shutter rate. Since Sakamoto does not appear to disclose the features set forth in the Office Action, the rejection of claims 5 and 6 as being obvious over Ishii and Sakamoto is incorrect.

While column 12, line 45, indicates that discharge tube 46 causes a strobe illumination to be completed in 1 millisecond or less, there appears to be nothing in column 12, lines 45+, and column 14, lines 32+, of Sakamoto to indicate the shutter rate is 10 milliseconds. The Examiner is requested to more specifically identify where Sakamoto discloses a 10 millisecond shutter rate if this allegation is repeated.

Applicant traverses the rejection of claims 1, 7-9, 11, 13, and 14 under 35 U.S.C. §103(a) as being obvious over Ariga et al. (U.S. Patent No. 6,115,068) in view of Shinoda et al.

The Office Action admits Ariga et al. does not disclose a strobe flash for illuminating an object plane in combination with electronic pulse circuitry to pulse a strobe flash at a rate sufficiently quick that the illumination appears to the user of a

camera to be substantially steady owing to persistence of vision. In addition, the Office Action concedes that Ariga et al. does not disclose each image being captured with at least one pulse from a strobe flash, wherein the shutter is adapted to capture images at a rate substantially below the rate at which the strobe flash is pulsed.

The Examiner says Shinoda et al. discloses these features for the same reasons advanced in connection with the rejection of claim 1 as being anticipated by Shinoda et al. However, this reasoning is incorrect for at least the same reasons as discussed above in connection with the rejection of claim 1 as being anticipated by Shinoda et al. Consequently, the obviousness rejection of claims 1, 7-9, 11, 13, and 14 is wrong.

In this regard, Applicant notes that independent claims 11 and 13 require (1) the strobe flash to be pulsed at a rate which is sufficiently quick that the illumination appears to a user of the camera to be substantially steady owing to persistence of vision and (2) the shutter to be adapted to capture images at a rate substantially below the rate at which the strobe flash is pulsed.

Applicant traverses the rejection of claims 13 and 15 under 35 U.S.C. §103(a) as being obvious over Ariga and Shinoda et al. and further in view of Katayama et al. (U.S. 2002/0126890). Claims 12 and 15 respectively depend on claims 11 and 13.

Katayama et al. does not cure the previously noted deficiencies in the rejection of the independent claims. Consequently, the rejection of claims 12 and 15 is incorrect.

In view of the foregoing amendments and remarks, favorable reconsideration and allowance are deemed in order.

To any extent necessary, Applicant hereby requests an extension of time in which to file this paper. The Commissioner is hereby authorized to charge any omitted fees, including extension of time and extra claims fees, to Deposit Account 07-1337.

Respectfully submitted,

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Persistence of vision

According to the theory of **persistence of vision**, the perceptual processes of the brain or the retina of the human eye retains an image for a split second. This theory supposedly accounts for the fact that when a motion picture flashes a series of progressive images, instead of the mind seeing the flashing of a series of images, it sees the illusion of motion.

In actuality, psychologists and physiologists have long ago abandonded this theory's applicability to film viewership, though film textbooks, film professors, and film theorists have largely not.

Persistence of vision should be compared with the related phi phenomenon. A critical part of understanding these visual perception phenomena is that the eye *is not a video camera*: there is no "frame rate" or "scan rate" in the eye: instead, the eye/brain system has a combination of motion detectors, detail detectors and pattern detectors, the outputs of all of which are combined to create the visual experience.

The frequency at which flicker becomes invisible is called the flicker fusion threshold, and is dependent on the level of illumination.

Film systems

Through experience in the early days of film innovation, it was determined that a frame rate of less than 16 frames per second caused the mind to see flashing images. Audiences still interpret motion at rates as low as ten frames per second or slower (as in a flipbook), but the flicker caused by the shutter of a motion picture projector is distracting below the 16-frame threshold.

As of 2002, theatrical film runs at 24 frames a second. This is the case for both systems using physical film and digital film systems.

It is important to distinguish between the frame rate, and the flicker rate, which are not necessarily the same. In physical film systems, it is necessary to pull down the film frame, and this pull down needs to be obscured by a shutter to avoid the appearance of blurring, there needs to be at least one flicker per frame in film. To reduce the appearance of flicker, many projectors add additional flicker periods, typically doubling the flicker rate to 48 Hz, which is less visible.

In digital film systems, the raster scan rate may be decoupled from the image update rate. In some systems, such as the DLP

system, there is no flying spot or raster scan at all, so there is no flicker other than that generated by the temporal aliasing of the film image capture.

The new film system MaxiVision 48 films at 48 frames per second, which, according to film critic Roger Ebert, offers even a flickerless tracking shot past picket fences. The flickerless shot is due to the higher sampling rate of the camera.

Video systems

Video records at an equivalent to 25 or 29.97 "frames" per second depending on the national system used; television thus displays a complete new image at 25 or just under 30 times a second.

Again, with video, the flicker rate is not the same as the frame rate. Each complete frame is divided into two "video fieldss" of alternate lines, and the two fields are shown consecutively to make up a frame. Thus, the field rate of video is twice the frame rate.

Some modern video systems also decouple display from image update, for example systems using LCD monitors or intermediate frame buffers to increase the display rate.

Cartoon animation

In drawn animation, moving characters are often drawn "on doubles", that is to say, one drawing for every two frames. This is an effective frame rate of 12 Hz. However, even though the image update rate is so low, people are used to seeing cartoons at this frame update rate, and the effect is quite satisfactory.

Persistence of vision is also:

- the name of a short story by John Varley, and the title of one of his later anthologies.
- the name of a demo/cracking crew involved in the Atari ST Demo Scene
- the name of a freely available ray tracing software package, also known as POV-Ray

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